innings to be played. These probabilities are respectfully, $(\frac{7}{16})^4+4(\frac{7}{16})^3\cdot\frac{9}{16}=\frac{14749}{65536}$, and $(\frac{9}{16})^4+4.(\frac{9}{16})^3\cdot\frac{7}{16}=\frac{26973}{65536}$.

46. Proposed by J. A. CALDERHEAD, M. Sc., Professor of Mathematics in Curry University, Pittsburg, Pennsylvania.

Four men starting from random points on the circumference of a circular field and traveling at different rates, take random straight courses across it; find the chance that at least two of them will meet.

Professor Heaton says: "If the men are considered points the chance is 0." [A possible though difficult problem could be made of this one by using instead of men segments of straight lines moving along random secants of a circle, the velocity of the segments all being different. Editor.]

47. Proposed by HENRY HEATON, M. Sc., Atlantic, Iowa.

What is the average length of the chords that may be drawn from one extremity of the major axis of an ellipse to every point of the curve?

Solution by the PROPOSER.

The length of a single chord is

$$[(a-x)^2+y^2]^{\frac{1}{2}}=(1/a)[a^2(a^2-x^2)+b^2(a^2-x^2)]^{\frac{1}{2}}\,.$$

Put S=distance around the ellipse. Then the required average is $A=$

$$\frac{2}{aS}\int_0^{\frac{1}{2}S}[a^2(a-x)^2-b^2(a^2-x^2)]^{\frac{1}{2}}\,dS=$$

$$\frac{2}{a^2S}\int_{-a}^{+a}\frac{[a^2(a-x)^2+b^2(a^2-x^2)]^{\frac{1}{2}}\,[a^2(a^2-x^2)+b^2x^2]^{\frac{1}{2}}\,dx}{(a^2-x^2)^{\frac{1}{2}}}=$$

$$\frac{2}{a^2S}\int_{-a}^{+a}\frac{[a(a^2+b^2)-(a^2-b^2)x]^{\frac{1}{2}}\,[a^4-(a^2-b^2)x^2]^{\frac{1}{2}}\,dx}{(a+x)^{\frac{1}{2}}}$$

This is readily reducible to elliptic functions of the first and second order, but the expressions I have been able to obtain are involved radicals.

Also solved by *G. B. M. ZERR* and *J. F. SCHEFFER*.

NOTE ON PROBLEM 391

BY LEWIS NEIKIRK, BOULDER, COLORADO.

The man starts at O moving in a *perfectly random* manner. After t seconds suppose him at P and that during the next instant dt he travels through ds to m at an angle θ with the line OP. Let $PM=dr=ds\cos\theta=v\cos\theta dt$, since $ds=vdt$. He will escape from the desert if $\int dr>R$ (the radius) the limits of inte-

gration being those which correspond to 0 and T of t; that is, if $\int_0^T v\cos\theta dt > R$. But this integral depends upon two independent variables. Indeed, θ, being wholly discontinuous from point to point according to the conditions of the problem, can not be considered a variable at all. If however, we assume θ constant (i. e. if the "perfectly random" motion of the problem means motion in a logarithmic spiral) then the condition above reduces to $vT\cos\theta > R$; or $\theta > \cos^{-1}(R/vT)$, agreeing with Professor Anthony.

NOTE ON PROBLEM 39.

BY J. BURKETT WEBB, C. E., PROFESSOR OF MATHEMATICS AND MECHANICS, STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, NEW JERSEY.

It seems to me that every such problem should have a complete and intelligible *physical* idea behind it, and further that a solution should be a development of the *physical ideas* of the problem, mathematics being simply the grammatical language of physics.

If Professor Anthony has a complete idea in the problem it is not intelligible to me and so it may be best to state the difficulties which appear to me.

It is to be inferred from the solution that the "perfectly random manner" means that the path consists of differential elements of equal length and all possible directions arranged in a chance succession.

If so the man will never reach the edge of the desert, or, stated otherwise, he will have but one chance in an infinite number of doing so.

In the solution the *rate of approach to the circumference* is spoken of; in random movements there would be no such rate except as the average of actual rates and this is not the use made of it.

The solution also supposes the man at each instant to go *within the angle* MPK, but this he does not need to do to get off in the time; so the deduced chance seems not to follow.

In fact the chance C=etc., is the answer to a different problem, as I see the matter, namely: Of all logarithmic spirals joining the center and circumference, having their origins at the center of the circle and differing from each other by equal increments of the angle between the radius vector and curve, what is the chance of choosing at random one whose included arc shall be less than Tv?

To make the problem apply to the case, for which it was I suppose, intended, of a wanderer in a desert I think one of two things will be needed. Either a certain finite length of step, taken at random must be fixed, or a law established to make large changes of direction less likely than small ones.